ilar to those resulting from the use of concentrated nutritive solutions. If such structures were brought into atmospheric air vegetative myceliæ were formed. Spores which had been immersed in pure CO_2 for three months germinated in the usual manner. In confirmation of Brefeld's work, Lopriore finds that Saccharomyces will not grow in pure CO_2, although but one-six thousandth part of oxygen is necessary as has been found by Brefeld. After 12 hours' immersion in the pure gas growth was resumed upon access of atmospheric air. Mixtures containing large proportions of CO_2 exerted a much stronger adverse influence upon Mycoderma cerevisiæ, which was killed by twelve hours' exposure to the pure gas.

Pollen grains reacted to mixtures in the most varied manner. Some formed protuberances in the pure gas, and then burst; in others no change was visible, while in others disintegration shortly ensued. Tubes formed in air and exposed to pure CO_2 were generally quickly destroyed. Proportions of 1 to 10 parts of CO_2 promoted the growth of the tubes, but did not increase the turgidity, which, however, was markedly increased if afterward brought into ordinary air. It will be remembered that in pollen tubes growth-extension of the walls is practically independent of turgidity. In many instances important changes in the plastic and elastic extensibility of the cell wall were induced, in a manner similar to the effects of strong oxygen solutions.

The results of Lopriore's work point to the conclusion that CO_2 exercises a retarding influence upon the activity of protoplasm, while directly exposed to it, but has no permanently injurious effect. Different plant cells exhibit widely divergent reactions to the gas. It appears quite well established that animal protoplasm is affected much more strongly by increased proportions of the gas. The influence of the gas upon the protoplasm of plant cells is characteristic, and its effects do not result from the simple exclusion of oxygen; its action is upon the nutritive processes, and since the widest disproportion exists between the volume and the effect produced, if it exercises any stimulating influence the reaction must be so limited as to be easily obscured.

The establishment of the fact that CO_2 exercises a positive influence upon protoplasm makes necessary a revision of some of the conclusions reached concerning ærobic and anærobic organisms, and particularly the researches of Correns (*Flora*, 1892) upon the relations of plants to oxygen, in which oxygen was partly or entirely displaced by CO_2. The anomalous reactions of tendrils obtained by this author seem to be capable of explanation in view of the recently discovered relations of the gas to plant protoplasm.

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NOTES ON CERTAIN UNDESCRIBED CLAY OCCURRENCES IN MISSOURI.

THE geologically well-known clays of the State of Missouri (which are very abundant and widely known, commercially), occur in the Quaternary—chiefly confined to the loess deposits along the larger rivers; in the Tertiary—in the southeastern part of the State; and in the Coal Measure formations —in the extension of the Iowa Coal Basin southwestwardly, and also in the small outlier of the Illinois Coal Basin, which is confined, practically, to St. Louis city and county.

Another interesting and commercially valuable group of clays, which has, apparently, never been described, includes a large number of more or less isolated pockets of fire clay and 'kaolin,' occurring unconformably in cavities and former valleys among the Silurian and, possibly, in some Devonian and Lower Carboniferous rocks. These pockets of clay are distributed over

a number of counties ranging, inclusively, from St. Charles, Warren, Montgomery and Callaway counties (which lie west of St. Louis), on the north; through Jefferson, Franklin, Gasconade, Osage and Maries, to Crawford, Phelps and possibly other counties on the south, the whole area occupying about the center of the eastern half of the State, its northern boundary being but a few miles north of the Missouri river.

These clays are of uncertain geological age. The beds of clay as they now occur are probably the last remnants of a once very extensive formation in this region. They are to be found mostly in the minor lateral valleys along the borders of the greater ones, and apparently always near the tops of the valley sides. They sometimes occur in shallow pockets along the tops of the divides, this being especially noticeable in Gasconade county, where these clays occur over a wide area. The greatest thickness of this clay seen by the writer, was at Regina, Jefferson county, where a pocket had been opened to a depth of sixty feet. Borings have been made in pockets which seem to belong to this class, which penetrated the clay to a depth of one hundred and twenty-five feet. In all of the many pits of this sort observed the contact between the clay and the surrounding sandstones or limestones was sharply unconformable, and indicated the origin above suggested.

The clay is usually cream-color, but is often mottled with purple and reddish tints, which are organic stains and readily disappear on ignition. It is mostly hard and brittle, breaks with a conchoidal fracture, and weathers concentrically, breaking up indefinitely into sharp, angular fragments. It is mined (as a fire-clay) mostly in Montgomery, Warren, Franklin, Crawford, Gasconade and Phelps counties, for shipment only, going to fire-brick works in St. Louis, Chicago and Eastern cities, where it is used in connection with more plastic clays to diminish their shrinkage.

In one locality near Union, in Franklin county, the upper four or five feet of this clay is plastic. Another variety occurring in many places is white, brilliantly mottled with reddish tints, and sometimes stained very dark purple; is comparatively soft and free from sand; has a smooth, soapy feel and is cut with a knife in an extremely smooth, soft way.

These three phases, the hard fire-clay, the plastic clay, and the last-mentioned variety —called locally 'kaolin'—may represent different horizons in this group of clays, and it is probable that the variety called 'kaolin' is part of the same formation which is found southeast of this region, where it has been considered a true kaolin, occurring in the place of its origin among the parent crystalline rocks.

The only trace of organic remains found in this group by the writer was taken from the clay pit of Isidor Mandle, in Regina, Jefferson county (where the clay is worked and shipped east to porcelain factories). This specimen consisted of a piece of beautifully carbonized wood, nearly two feet in length, and five inches by three inches, in cross section, at its larger end, whence it tapered towards the other end to about half that size. A piece of this wood was sent to Prof. F. H. Knowlton at the Smithsonian Institution, who prepared sections of it for microscopic examination and kindly furnished the writer with the following information in regard to it, which is given in his own words:

"The structure is very finely preserved and comes out beautifully. It belongs to the genus Dadoxylon, and is very close to Dadoxylon Beinertianum Endl., from the Sub-carboniferous Falkenburg in Silesia. The wood cells have one, or more often two, alternating rows bordered with oblong cells

or inner pores, those on the opposite sides being placed at right angles, thus producing a kind of maltese cross within each circle. This is very characteristic of the Palæozoic genus Dadoxylon, and your material cannot by any means have come from the Tertiary unless it has been redeposited. The specimen itself is Palæozoic, and the question of its possible removal from its original position is, of course, one of stratigraphy."

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NOTE ON A BREATHING GAS WELL.

A VERY remarkable gas well recently came under the writer's observation while engaged in studying the geology of the Santa Lucia Range. It is situated on the Eagle Ranch, on the eastern side of the Range in San Luis Obispo county, California.

The well is interesting on account of two things: (1), the presence of gas in the Golden Gate series, it being encountered while boring for water; and (2), the intermittent flow of gas, the periods of flow alternating with those of drawing in air.

The geology of this portion of the range is quite complicated. In the vicinity of the Eagle Ranch there are four different formations; the oldest, the Golden Gate series, consisting of shale, sandstone and jasper, with numerous ancient eruptives, the whole being probably of Upper Jurassic age. The rocks of this series are extensively developed through the Coast Ranges of California, but have never before been found to contain gas, nor have any indications of coal or oil been met with.

The well was bored on the point of a hill rising perhaps seventy-feet above a little flat on which the ranch buildings are situated; this flat is underlaid by Lower Cretaceous shales which surround the hill on three sides. The Chico sandstone occurs, overlying the shales in various places; while to the east, some distance away, the Bituminous Slate series (Miocene) is met with filling the Salinas Valley. The Miocene is preëminently the oil and gas bearing formation of California. The writer does not know of any locality in the State where gas is obtained in quantities sufficient for use from beds of Cretaceous age, although such may be the case.

The well under consideration has a bore of six inches and was put down to a depth of three hundred and fifty-six feet. The strata passed through consists of shale and sandstone having a very steep dip. They are exposed on the south side of the hill at a distance of a little more than a hundred feet from the well, and exhibit the intense distortion of and shearing so characteristic of the Golden Gate series. When first bored, the water rose to within about eighty-five feet of the surface. A small amount of gas was encountered at a depth of ninety feet. Comparatively little gas came from the well at first, but during a stormy spell the well was pumped continuously for some time, and as the water grew lower a noticeable amount of gas began to issue. This increased until it was estimated to amount to twenty thousand feet per day. This state of things lasted for about six weeks, when the volume began to decrease, finally becoming intermittent. The well has now been opened for four years, the gas continuing to average about 250 feet per day. During settled weather the intermittent action is fairly regular, the gas issuing for about three hours, when an equilibrium being reached, the current changes and air is sucked in for the same length of time. If the air is not allowed to enter the gas will not flow; consequently an automatic valve has been placed at the surface of the well, permitting the ingress of the air. The suction is frequently so strong that, if only a small opening is left a roaring sound is produced, which is audible at the ranch house.